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# The U.S. Machine Tool Industry

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# **THE U.S. MACHINE TOOL INDUSTRY**

## **ABSTRACT**

The U.S. machine tool industry is suffering from tough competition. Once the world's leader in machine tool production, the Japanese and Europeans have taken that lead with high quality, computer integrated, competitively priced equipment, which can be delivered quickly. Factors affecting U.S. competitiveness include the sluggishness of the U.S. economy and its impact on the manufacturing industry, the strength of the dollar overseas, labor costs, and the extreme volatility of the machine tool industry production cycles. The industry can improve its competitive posture by expanding from regional markets into the global market, increasing research, development, and capital investments to remain the world's technological leader. The U.S. government can facilitate a resurgence in the industry by modifying or abolishing laws which disincentivize investment and pose barriers to entry into foreign markets.

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## INTRODUCTION

Machine tools are the master tools, the tools that make tools. Virtually every product is built on a machine tool or on a machine made by a machine tool.<sup>1</sup>

Losman & Liang, 1990

The machine tool industry has seen a decline in the U.S. market, with production bottoming out in the early 1980s. Over the past decade, U.S. machine tool imports have exceeded exports by as much as \$1.5 billion. Something in the U.S. industry has gone awry.

This paper discusses the current state of the machine tool industry, the reasons for its decline, and suggests some strategies for its recovery.

## **DEFINITIONS**

A **machine tool** is ". . . a power-driven machine, not hand-held, that is used to cut, form or shape metal."<sup>2</sup>

Machine tools are classified within two major industry subgroupings: Standard Industrial Classification (SIC) code 3541, **metal cutting machines**, and SIC 3542, **metal forming machines**. Metal cutting machines remove metal by boring, broaching, drilling, electrical discharge, gear cutting, and grinding. Metal forming machines form metal by forging, die-forming, shearing and bending machines.

## **BACKGROUND**

### **A SNAPSHOT OF THE INDUSTRY--DEMOGRAPHICS, PRODUCTION AND EMPLOYMENT**

There are over 2.3 million machine tools in the U.S. Machine tool builders have moved westward, from an initial concentration in the the New England area, to the Midwest and West, following automobile manufacturers and aerospace industries. Many of the machine tool businesses are family owned, though some fall under the umbrella of large conglomerates.

U.S. machine tool production is dependent upon demand. Figure 1 shows how production has oscillated over the last thirty years. Income, profits,

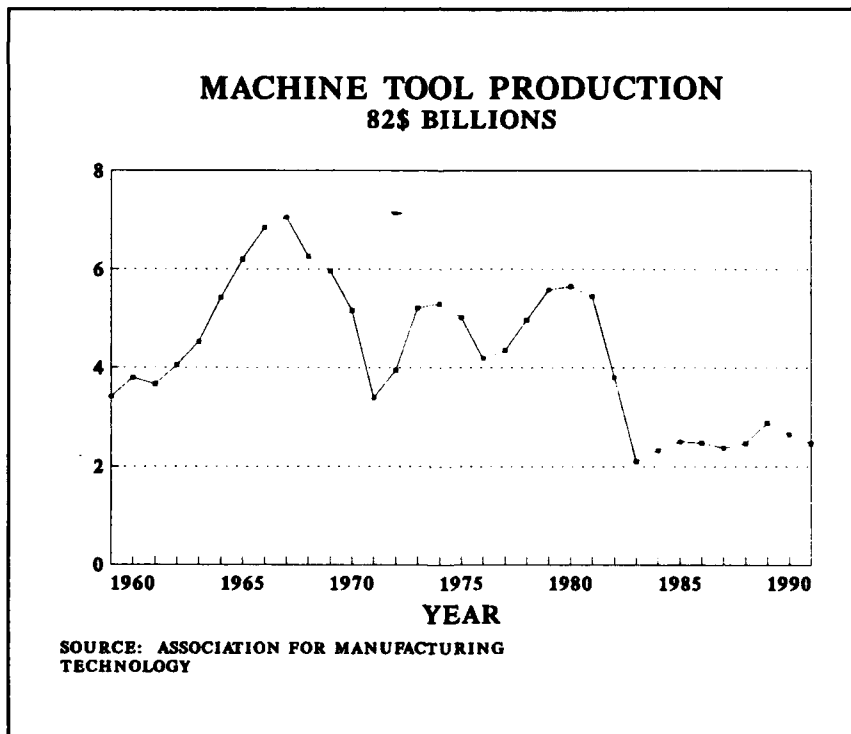


Figure 1



cash flows, and employment in the industry follow corresponding cycles. Changes in net new orders also experience dramatic shifts from year to year. These cycles "may be as long as ten years from peak to peak. On a year-to-year basis, variations from +90 to -75 percent have occurred."<sup>3</sup> The phenomenon where "Relatively small cycles in the demand for final goods become multiplied into larger cycles in the durable or investment goods industries (machine tool industry) . . . is known as the 'accelerator effect.'"<sup>4</sup> See Figure 2. This effect is evident when relatively small changes in the demand for a final product force significant changes in the demand for capital equipment. For example,

. . . a company uses lathes for the manufacture of its products. Assume that its manufacturing base consists of ten such lathes and that, because of wear, one replacement lathe is purchased each year. Should the company, in response to demand, decide to increase its output, it may find that a relatively small production increase, say 10 percent, may require the purchase of an additional lathe beyond its yearly replacement. Here a modest increase in production can lead to a 100 percent increase in the company's lathe demand. The accelerator function can of course work in a downward demand direction as well.<sup>5</sup>

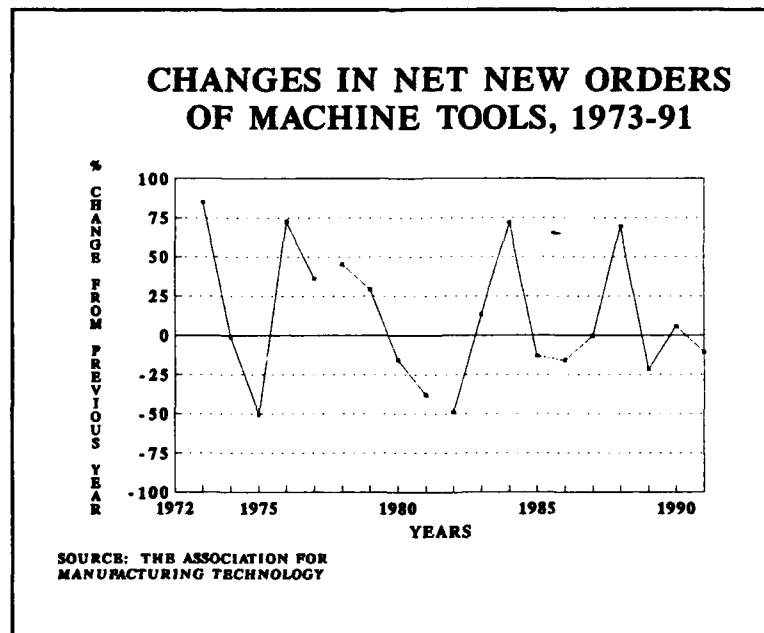


Figure 2

Backlogs during high demand can run from 18-24 months, followed by cancellations if the economy begins to slow down. For the entrepreneur who can provide a quick response and economical prices, the market becomes a prime target. Although representing less than .1 percent of gross domestic product (0.06% in 1991), the machine tool industry characterizes much of the manufacturing sector, which experiences similar swings.

There are approximately 59,500 personnel (1991) employed in the machine tool industry. Figure 3 shows the distribution of firms by size of workforce.

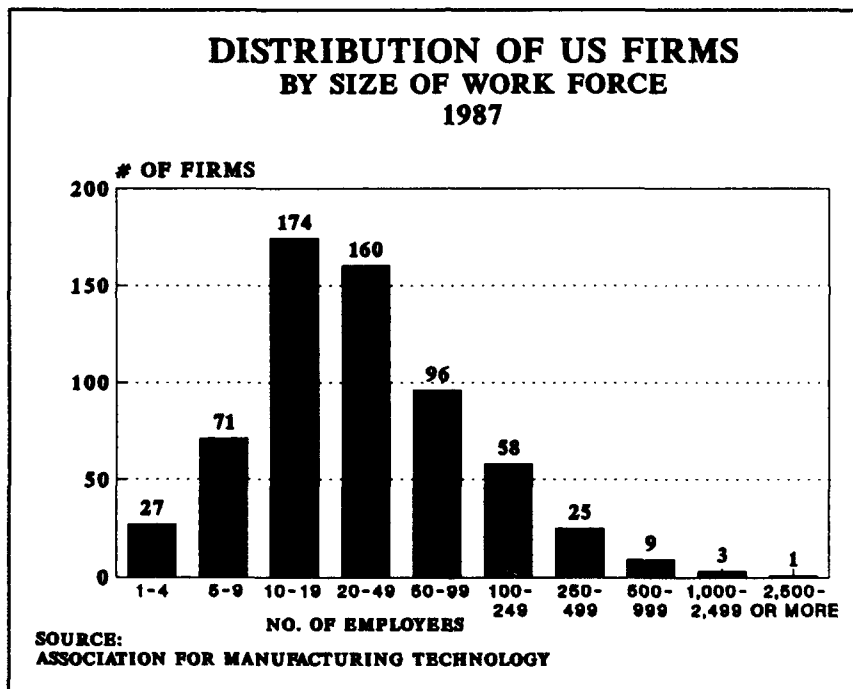


Figure 3

## DISCUSSION

### PROBLEMS IN THE INDUSTRY

The Massachusetts Institute of Technology (MIT) Commission on Industrial Productivity published results of a study of the machine tool industry.<sup>6</sup> Their findings revealed

several factors leading to the industry's decline in the early 1980s.

a. U.S. manufacturing demand is down. The machine tool market reflects the state of manufacturing in the U.S. When the market shrinks in other areas, such as automobiles and defense, there is a corresponding reduction in demand for machine tools. Machine tool orders

... are considered a useful forward-looking barometer of industrial health because they play a key role in the output of a broad range of goods, from kitchen appliances to jet engines. When orders for machine tools rise, it signals manufacturer confidence that orders for their own products will rise as well."<sup>7</sup>

b. Other materials are replacing metals, resulting in a reduction in demand for metal working tools.

c. Imports in the U.S. market are growing. U.S. imports have consistently exceeded exports by 200 percent since 1982. See Figure 4.<sup>8</sup>

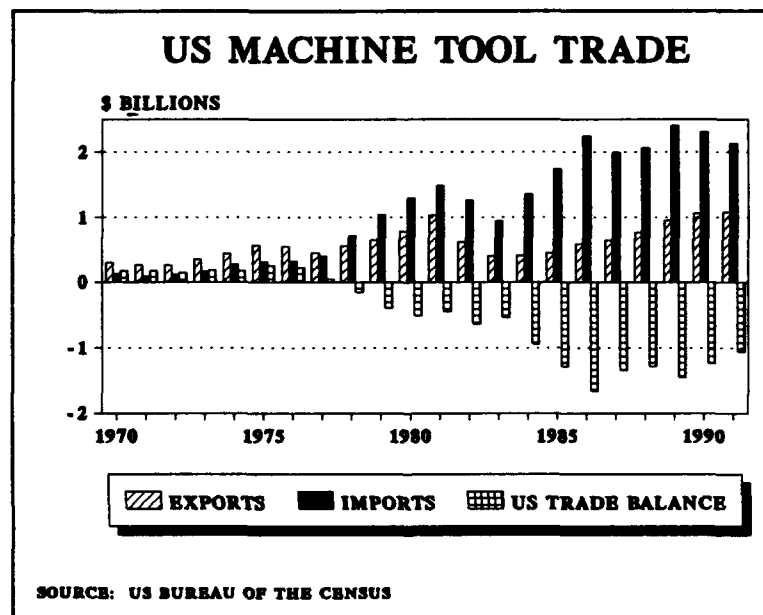


Figure 4

d. The U.S. was once the top producer of the world's machine tools. Today, foreign competitors, including Japan and Germany, have each surpassed total U.S. production. In 1991, Japan produced \$11.6 billion in machines, with exports of nearly \$4.0 billion and \$1.6 billion in imports. During the same period, Germany produced \$8.8 billion, exported \$5.1 billion and imported \$2.3 billion. By comparison, the U.S. produced \$3.3 billion, exported \$1.9 billion and imported nearly \$2.0 billion in machine tools, excluding parts and accessories.<sup>9</sup> U.S. companies have been slow to recognize and respond to the global impacts of the market--they have not been export oriented. Only five U.S. companies rank in the top 50 producers. The rest are Japanese, German, Italian, Swiss, and French.<sup>10</sup>

The Japanese and Europeans have penetrated the U.S. market. The Japanese targeted the low- and mid-priced metal cutting machines, while the Europeans focused on the U.S. dependent high-end machines, such as grinders and polishing equipment. In the mid- to late-1980s, these countries sold their machine tools at prices 20 to 40 percent less than the U.S. Production costs and exchange rates made this possible.

Labor costs drive up production costs. Japanese hourly earnings in the mid-1980s were 36 percent less than the U.S. As a result, the overall production costs for machine tools in Japan were approximately 23 percent lower than similar machines in the U.S.<sup>11</sup>

U.S. imports rose from less than four percent in 1964 to just under 24 percent in 1980. "Between 1980 and early 1985 the effective exchange rate of the U.S. dollar rose by almost 60 percent. The period of the "superdollar" caused U.S. goods to become more expensive to foreigners while goods produced abroad became cheaper in the U.S."<sup>12</sup> In a small market with an elastic demand, spending one out of every two dollars on imported

machinery has a devastating impact on domestic production. Baumol and Blinder state that

Holding other things equal, countries with high interest rates are able to attract more capital than are countries with low interest rates. Thus a rise in interest rates often will lead to an appreciation of the currency, and a drop in interest rates will lead to depreciation.<sup>13</sup>

They add, "It certainly played a predominant role in the stunning movements of the U.S. dollar during the 1980s. . . Interest rates rose well above comparable interest rates abroad. In consequence, foreign capital was attracted here, American capital stayed at home, and the dollar soared." See Figure 5.

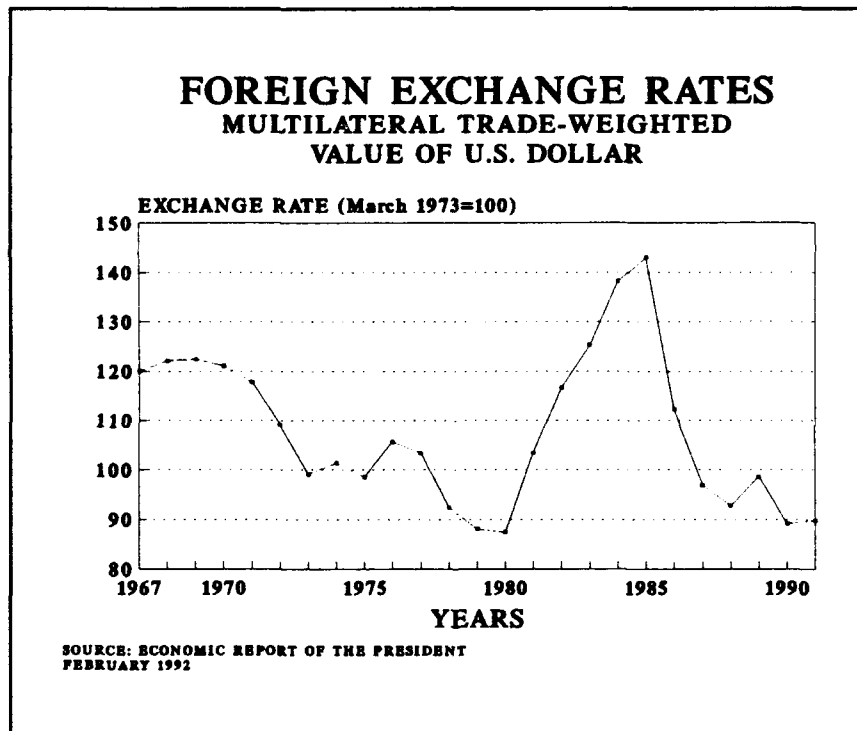


Figure 5

The machine tool industry suffered from the foreign competition attracted by the differences in labor costs and exchange rates.

e. Smaller, family owned businesses have failed to invest in research and development (R&D) and capital equipment. R&D is necessary to compete technologically, and modern capital equipment is necessary for more efficient production. With some exceptions, these companies supported regional markets, ignoring technological developments employed by their foreign competitors.

f. Some conglomerate absorption of machine tool builders in the 1960s and 1970s disregarded long term management and planning. They focused on "quarterly earnings," and adopted a shorter view. During periods of high returns for machine tool companies, conglomerates often skimmed profits from the machine tool sector to finance other ventures. Consequently, they tended to drop specialty machines, concentrating instead on high volume products. The equipment deteriorated and the conglomerates did not make capital equipment investments.

## **THE RECOVERY OF THE INDUSTRY**

There are no easy solutions to the dilemma; the problems are much larger than the industry itself. This industry requires changes in the way it does business. Several strategies are offered for consideration.

### **Desirable Alternatives**

- *Expand into global markets.* Competing with the Japanese and Europeans requires global marketing and sales of U.S. built products. Global competition requires a change from a regional marketing mentality to one of global proportions. U.S. machine tools must meet or exceed the competition in price, quality, technology and reliability.

Competition encourages efficient production, ensures that the economy's resources are put to their best use, and accommodates changes in consumer demands.<sup>14</sup> Global competition can increase exports and counterbalance the trade deficit.

- ***Expand into multinational corporations.*** Multinational corporations manufacture U.S. products abroad, breaking through some of the barriers to market entry. For example, they don't be required to pay tariffs on exports since they will be producing the product on foreign soil. At the same time, these corporations have the capacity to capture a fair portion of the market.

- ***Encourage technological innovation.*** Technological superiority is one of the keys to staying competitive. Manufacturers need to replace their aging equipment with modern, state-of-the-art equipment that will increase their efficiency and productivity. The Japanese took the lead in integrating computers and electronic technology in their machine tools. The U.S. can compete in technology by investing in research and development (R&D). It is an investment in the industry's future.

- ***Encourage capital investments.*** Current tax laws do not encourage capital investment. Revising the laws to provide tax credits for investments would encourage replacement of old and deteriorating equipment with more efficient and technologically superior machines.

- ***Encourage larger industries to expand by incorporation of the small machine tool builders.*** One problem often facing the smaller business is the lack of capital to make any significant investments in R&D and equipment purchases. Larger companies, taking advantage of economies of scale and diversification to reduce risk, often find themselves with

the financial stability to make investment ventures. This can be facilitated by an easing of anti-trust laws that prevent mergers. However, as discussed earlier, this may be a disadvantage if the larger company procures the smaller machine tool builder as only a short term investment, taking the quick profit and selling the company when those profits decline.

- *Encourage expansion into alternative, related industries experiencing technological growth, such as computer aided design and manufacturing and composites.* In 1991, just over one half of Cincinnati Milacron's \$754 million in sales were from machine tools (\$383.7 million).<sup>15</sup> This company is expanding from metal working machinery into alternative markets for machine tools, including plastics (injection molding machines) and composite material production machinery.<sup>16</sup> Diversification ". . . spreads risk and makes use of its established capabilities in new lines of business."<sup>17</sup> For a machine tool builder to diversify into an industry with similar markets, those risks tend to be reduced. As market shares go up and sales stabilize, the business cycles will flatten out.

#### Acceptable Alternatives

- *Enforce Buy American Act in defense procurement.* As a matter of national security, it may be important to keep a "warm industrial base" in some sectors of industry.

Jaques Gansler states in Affording Defense,

We have become a 'consumer society' rather than an investment society, and we have tended to shirk our responsibility to invest in long-term manufacturing productivity. For this reason, many still argue that unless the Department of Defense continues to support the nation's manufacturing-technology efforts, the United States will continue to lag in this crucial area.<sup>18</sup>

The Buy American Act requires the U.S. military to give preference to items, such as machine tools, to be made in America. The media uncovered several instances where the



military allegedly violated the act.<sup>19</sup> If the government finds it necessary to legislate government purchases from American business, then it should ensure both buyers (the government purchaser) and sellers comply with the law. However, this act should only apply to those critical sectors that our national security is clearly at risk.

- *Encourage foreign investment in U.S. machine tool companies.* Foreign investment in this country creates jobs, brings in capital and technology, increases our productivity and, therefore, our standard of living. In his discussion on foreign investment in the U.S., Robert Reich states,

Government policy makers should be less interested in helping American-owned companies earn hefty profits from new technologies than in helping *Americans* become technologically sophisticated. It makes perfect sense, then, to encourage Sony, Philips, Thompson, NEC, or any other global company to train Americans to design and make advanced . . . exotica of the future. Invite them in; we need the training.<sup>20</sup>

It also stimulates competition between the foreign investors and American builders. As stated in the first alternative to expand into global markets, "foreign investment . . . recognizes that unhindered international flows of capital are beneficial to home and host countries alike."<sup>21</sup> In this case, the U.S. is the host country.

### **Undesirable Alternatives**

- *Nationalize the industry.* If this country's machine tool industry was deemed absolutely essential to the nation's survival, and it could be characterized as a monopoly or near monopoly, then nationalization might be the answer. For example, the government operates the U.S. Postal Service to provide a cost advantage over competition. Despite some successes, nationalized industries continue to lack incentive for efficiency.<sup>22</sup> Nationalization

of the machine tool industry would provide unnecessary protection to an industry fully capable of providing this country with a competitive resource to the manufacturing sector.

- *Enact protectionist laws to reduce competition.* Enacting legislation to keep out foreign intervention and to protect the domestic industry also leads to the stagnation and lack of innovation resulting from insufficient competition. Similarly, establishing price supports, while providing short term benefits to the smaller companies, only tend to exacerbate the problem. For example, price supports to help farmers

. . . have resulted in only temporary increases in small farm income while creating vast costly surpluses of all products with supported prices. Yet the small farmer remains in trouble and prospects for his survival have not been enhanced. The fate of small farmers is soon to be that of the harness makers and buggy producers who flourished at the turn of the century but were gradually displaced by technological innovation . . . Attempts to preserve competition through preserving the number of competitors . . . is merely an attempt to halt the efficient working of a competitive market.<sup>23</sup>

- *Authorize additional government purchases of machine tools during slower periods in the business cycle.* This alternative may be considered a government subsidy to preserve the industry, which, as I've discussed, circumvents the advantages of the free market. Unless such practices are done judiciously, such as an aid for an infant industry to get established, they tend to glut the market with unnecessary equipment. In the long run, more damage will occur than if the market forces drive the supply.

## IS OUR NATIONAL SECURITY AT STAKE?

How serious is the decline of the machine tool industry with regard to national security? As described earlier, machine tools form the foundation upon which our manufacturing sector is based. There are concerns with relying on a foreign country for the supply

of our nation's machine tools.

First, we run the risk associated with the foreign country regulating the flow of import machines into this country. In a time of reconstitution, this could prove to be an unsatisfactory situation.

Second, by not being a primary producer of machine tools, the U.S. will fall behind in the integration of new technologies, since the foreign countries will most likely develop and integrate the new technologies first.

In the current world situation, however, with the Cold War over and strong trade relations developing with many industrialized nations, a significant degradation of our national security is not taken seriously. By their very nature, machine tools have a life cycle of several years. If we are required to mobilize or regenerate sectors of industry, we will;

- a. do it with what we have available;
- b. generate new capacity from domestic or friendly resources or;
- c. be lead-time away from developing the quantity, whether domestically or foreign produced, of machine tools to meet defense industry demands.

Protecting the machine tool industry as a matter of national security assumes a worst case scenario of no foreign support, a highly unlikely situation.

### **SUMMARY**

The U.S. machine tool industry is suffering from strong competition, primarily from the Japanese and West Europeans. It has the capability and capacity to make a strong comeback. Productivity will increase by enhancing innovation and adopting new technologies, by

diversifying into similar industries to provide a more stable production base, and by expanding into global markets. Increased profits will provide capital for investments in R&D and equipment. A global vision will provide the incentive for U.S. machine tool builders to take the lead once again in technology and process improvements. Integrating some 'lessons learned' from the Japanese, such as building less expensive equipment with state-of-the-art technology, will make it easier for the manufacturing sector to shorten the life cycles of their capital equipment and replace it more frequently, increasing investment in the machine tool market. Maximizing competitiveness and minimizing government regulation will promote a strong recovery for the machine tool industry. Changes to tax and anti-trust laws can encourage capital investments that will help revitalize the industry.

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